Space Weather Technical Forecast

Issued on Sunday 23 March 2025 at 12:54 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: G1-G2 storms possible each day. Chance of G3 day 1 (23 Mar).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low in the past 24 hours, with occasional C-flares. There are nine sunspots on the Earth facing disc, the vast majority of which are relatively small and magnetically simple and either stable or in slight decay. AR4036, in the northwest quadrant, remains the most significant group, after a period of rapid growth, it has begun to consolidate within both the leader and trailer portions, though has seen a recent simplification in its magnetic classification.

A faint but quite wide angle CME was observed leaving the sun possibly associated with a filament lift-off from just south and east of centre disc, between 22/1300-1500 UTC. The lack of STEREO-A imagery has impeded the ability to triangulate this CME as definitively near or far sided, so a risk of an arrival on 24 Mar has been included.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by DSCOVR at L1, were indicative of a weak transient and/or coronal hole influences. Peak speeds of 520km/s were observed around 22/1900UTC, with an erratic reduction 430km/s thereafter. Density varied between above average and average. Interplanetary Magnetic Field, Bt, was initially moderate but soon declined to current weak levels. The north-south component, Bz, was weak, on a declining trend, and mostly negative, with periods of -8nT to +2nT. Phi angle was mostly negative (towards the sun), with a period of positive (away from the Sun) between 22/1900-23/0300UTC. Geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) was at background to moderate levels. The 24-hour fluence was below the Active threshold. The observed integrated pfu was 2.12e6 at 23/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Low activity is expected, with a slight chance of further isolated M-class flares.

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Solar Wind / Geomagnetic Activity: A faint halo CME was observed at 21/1558 UTC. This has been analysed as arriving at Earth during day 1 (23 Mar) bringing solar winds speeds at L1 of 600-700 km/s. There is a second CME, originating around 22/1400UTC, which is of lower confidence. This CME may arrive at Earth on day 2 (24 Mar). Otherwise, solar winds are expected to continue slightly elevated to elevated initially due to CH24/- influence, but are likely to become enhanced further with the halo CME arrival, perhaps reaching strong levels. Solar winds should then gradually decline through 24 and 25 Mar, before the potential arrival of the HSS from the large CH25/+ from late 25 into 26 Mar.

Unsettled to Active geomagnetic conditions are likely initially, before rising to G1/Minor to G3/Strong storming due to likely combined CH HSS and CME influences through day 1 (23 Mar). There is a chance of G1/Minor storms due to possible lingering CME effects/possible CME arrival on day 2 (24 Mar), then again on days 3 and 4 (25/26 Mar) due to the arrival of the HSS from CH25/+.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a slight chance of enhancement from any larger flares. High energy electron flux is expected to continue at largely background levels until later in the period, when it may become diurnally high. Electron (1e8 integrated pfu) fluence should remain below the Active threshold throughout the period, with a rising slight chance toward the end of the forecast.

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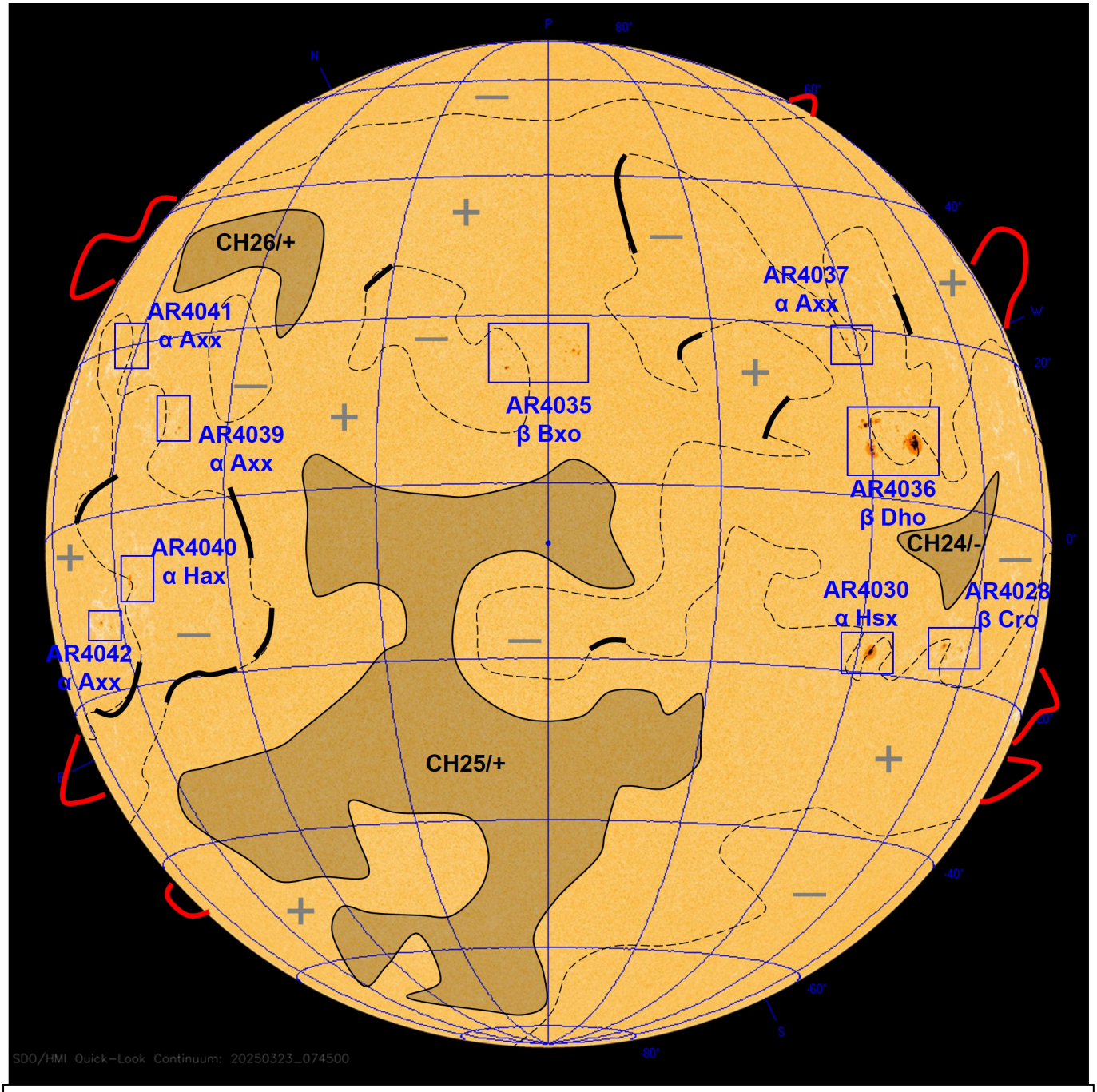
Figure 1: Solar Synoptic Map valid 23/0745UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A faint halo CME was observed leaving near centre disc following the M1.2 flare from AR4028 at 21/1558 UTC. This has been analysed as a fast CME with speeds in the region 800-1200km/s as it left the Sun, and is likely to arrive at Earth during day 1 (23 Mar) bringing solar winds speeds at L1 of 600-700 km/s. There is a second CME, originating around 22/1400UTC, which is of lower confidence. This CME may be associated with a small filament eruption near centre disk and was also at a similar time to two northern directed CMEs. Given the lack of STEREO-A imagery and the ability to triangulate this CME, it is not known for definite if this is a near or far-sided feature, with a possible arrival on 24 Mar, should it be near-sided.

Otherwise, solar winds are expected to continue slightly elevated to elevated initially due to CH24/- influence, but are likely to become enhanced further with the halo CME arrival, perhaps reaching strong levels. Solar winds should then gradually decline through 24 and 25 Mar, before the potential arrival of the HSS from the large CH25/+ from late 25 into 26 Mar.

Unsettled to Active geomagnetic conditions are likely initially, before rising to G1/Minor to G3/Strong storming due to likely combined CH HSS and CME influences through day 1 (23 Mar). There is a chance of G1/Minor storms due to possible lingering CME effects/possible CME arrival on day 2 (24 Mar), then again on days 3 and 4 (25/26 Mar) due to the arrival of the HSS from CH25/+.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	70	50	30	50
Strong	G3	No	30	20	1	5
Severe	G4	No	5	1	1	1
Extreme	G5	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
21/1830	Full Halo	M1.2/Filament	Centre	1200	23/1400	Faint so unlikely to be material-rich, but fast and possibly enhancing already fast winds and disturbed near earth environment.
22/1810	Partial	Filament	Centre (possibly far-side)	1000	24/1200	Low confidence on lift off and lack of STEREO imagery so could be far-sided.

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Figure 2: MOSWOC Enlil.

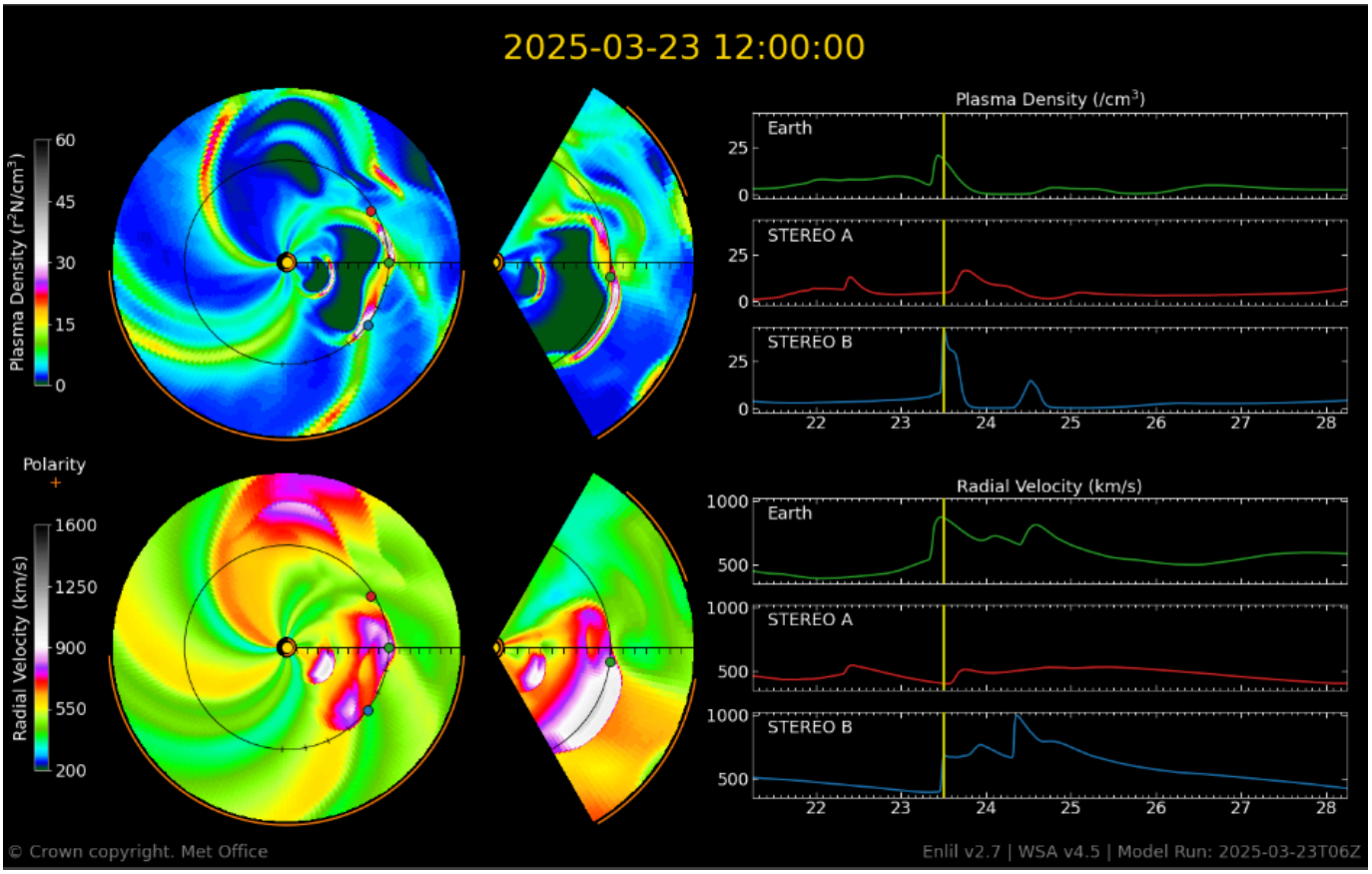

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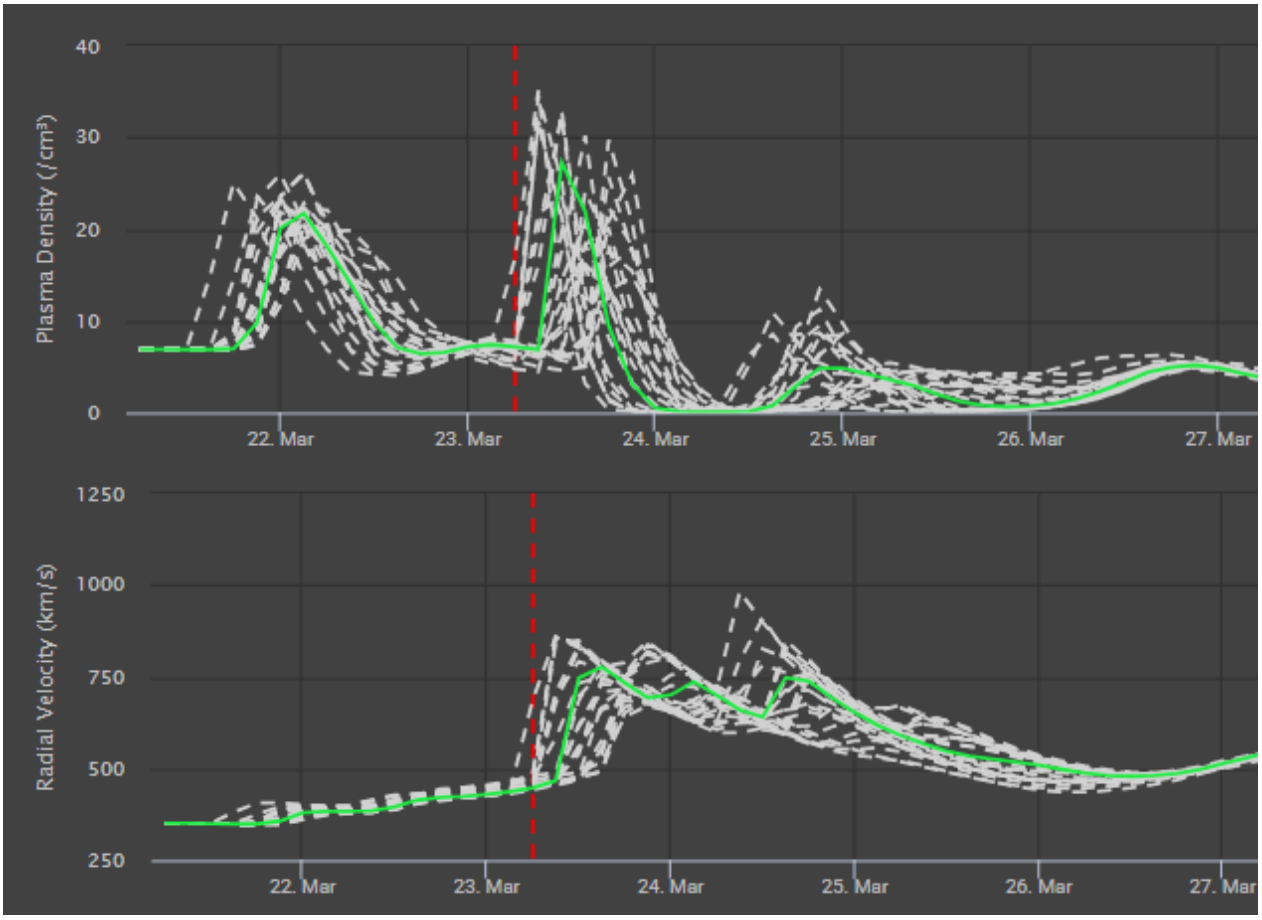
Figure 3: MOSWOC Enlil Ensemble.



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Radio Blackouts - X-Ray Flares

Solar activity has been Low in the past 24 hours, with occasional C-flares.

There are nine sunspots on the Earth facing disc, the vast majority of which are relatively small and magnetically simple and either stable or in slight decay. AR4036, in the northwest quadrant, remains the most significant group, after a period of rapid growth, it has begun to consolidate within both the leader and trailer portions, though has seen a recent simplification in its magnetic classification. Three of the previously numbered regions have either faded to plage or rotated around the limb.

Generally Low activity is expected, with a slight chance of isolated M-class flares. on a generally flat rend through the next 4 days.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	35	35	35	35
Very Active	R3-R5 (X Class)	No	1	1	1	1

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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux was at background levels. Proton flux is expected to remain at background levels, with only a slight chance of enhancement due to the current lack of large, complex spot groups on the Earth facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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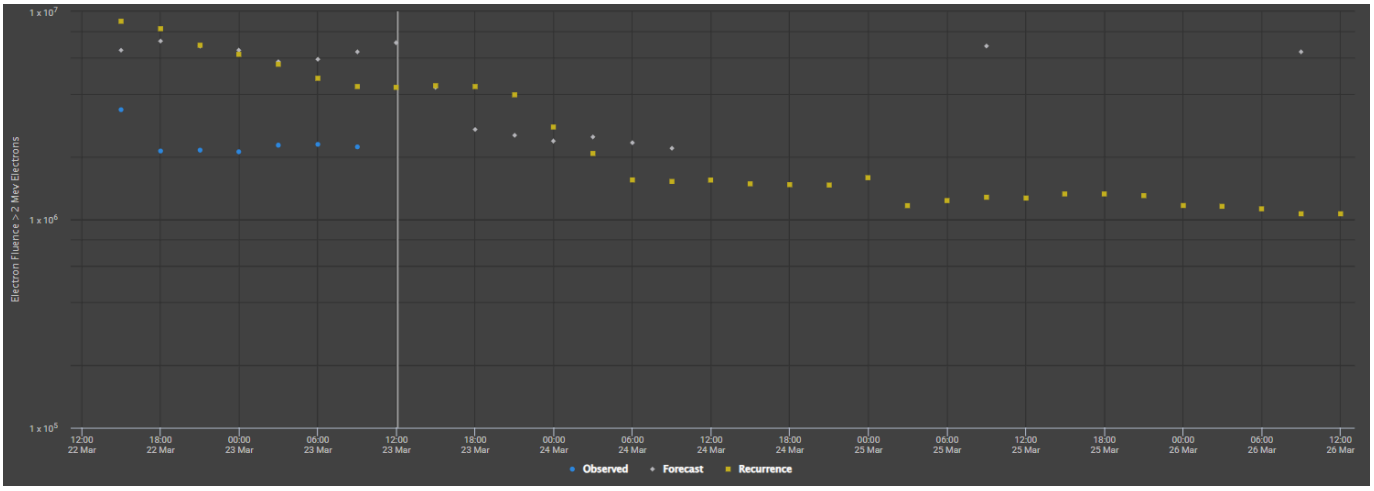
High Energy Electrons (≥ 2MeV)

GOES16 High energy (>2MeV) Electron flux was at background to moderate levels. With CME and CH HSS influences through the periods, flux levels are expected to remain at similar levels until later in the period, perhaps becoming diurnally high by day 4 (26 Mar).

MOSWOC REFM shows the electron fluence should remain below the Active threshold throughout the remainder of the period, and is considered reasonable guidance, albeit with low confidence as a slightly increasing trend towards the end of the period is possible.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	5	10	20
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM fluence forecast/observations/recurrence.



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